US-PAT-NO: 5590133

DOCUMENT-IDENTIFIER: US 5590133 A

TITLE: Apparatuses and mobile stations for providing packet data communication in digital TDMA cellular systems

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Application Filing Date - AD (1):
19941209

Drawing Description Text - DRTX (14):
FIG. 13 shows examples of a mobile originated and a mobile terminated packet transfer on an MPDCH, thereby illustrating the principles of using **Uplink** State Flags (USFs) and a type of paging that reserves an access slot for the MS to respond (applicable both to Embodiment I and II).

Detailed Description Text - DETX (7):
The packet data functionality added in BTS includes capability to provide one or more shared packet data channels (here referred to as "PDCHs"), depending on demand. In a cell, only occasionally visited by a packet data user, a PDCH may be allocated temporarily on user demand. In a cell with continuous packet data traffic demand on the other hand, one or more PDCHs may either be allocated on a semi-permanent basis, or be allocated dynamically, adapted to the current load situation. The allocation of PDCHs is controlled from BSC. The degree of PDCH support in a cell (continuous, on user demand, or no support at all) may be configurable. Information defining the support level and any PDCH, allocated for initiating packet transfer, is broadcasted on a regular GSM Broadcast Control Channel (BCCH). A PDCH is a new type of logical channel on a physical TDMA channel (time slot), optimized for shared packet transfer to and from multiple packet data capable MSs (supporting packet data only, or packet data combined with ordinary voice/circuit data services in different modes of operation). PDCHs are used for data transfer and associated control signalling. A "reservation-Aloha" type of protocol is employed. **Uplinks** and downlinks are basically used as independent channel resources. In a certain TDMA frame, a PDCH **uplink** may carry data from one MS and the downlink data to another. The packet data radio link protocol over the PDCH(s) allocated in a cell is handled by a "PD transfer controller" in BTS. In a BTS with at least one PDCH allocated, the PD transfer controller has a, normally unique, physical connection for packet transfer to and from MSC, utilizing ordinary internode trunks.

Detailed Description Text - DETX (43):
Coordination of the above procedures may be accomplished by employing for the MPDCH downlink a multiframe scheme similar to and synchronized with the 51-frame multiframe schemes used for regular GSM downlink control channels. Compared to idle mode, when an MS may listen to broadcast channels at any time except during its assigned (sleep mode) paging block, more extensive coordination is required for an MS in PD mode, and specifically when the MS is in normal paging mode. In the latter case, the time an MS is available for

downlink messages needs to be maximized, while allowing sufficient time for the broadcast listening tasks. A multiframe coordination scheme with this purpose is exemplified in FIG. 6 and FIG. 7. FIG. 6 shows an example of a 51-frame MPDCH multiframe, synchronized with the corresponding GSM Broadcast **Channel (BCH)/Common Control Channel (CCCH) and Stand-alone Dedicated** Control Channel (SDCCH) multiframes. As depicted in FIG. 7, 8 MPDCH multiframes form a multiframe cycle (synchronized with the corresponding BCH/CCCH and SDCCH multiframe cycles). FIG. 7 also illustrates an example of scheduling adequate times for the tasks of listening to and reading information from ordinary GSM broadcast channels.

Detailed Description Text - DETX (80):

The PDCH allocation controller in BSC which is processor-based and comprises both software and hardware. Together with the "circuit mode BSC", which has the overall responsibility for radio **channel resources, it coordinates allocation of PDCHs such that, from a common pool of physical channels** (time slots), a variable mix of TCHs and PDCHs may be allocated determined by demand. In this process, the PDCH allocation controller:

Detailed Description Text - DETX (107):

The TDMA structure and the need to allow for the same degree of timing disalignment at first MS access as in ordinary GSM have lead to the selection of a "reservation-Aloha" type of protocol. To initiate a packet transfer in the mobile originated direction, illustrated by the sequence diagram in FIG. 10, an MS makes a random access request (signal (1) in the figure) on the MPDCH **uplink** (using the same type of access burst as in ordinary GSM), when allowed to do so, as determined by "**uplink** state flags" (USFs) on the MPDCH downlink. The access burst includes a random number providing an initial identification of the MS, and may also include class of service type of information.

Detailed Description Text - DETX (108):

BTS normally responds with a channel reservation command (signal (2)) on the MPDCH downlink, reserving channel capacity for **uplink** data transfer and down link acknowledgement (ACK). (In case of no response from BTS, the MS makes a retry after a random backoff time.) The channel reservation command includes the same random number as received in the access burst, and timing alignment/power control (TA/PC) commands. The timing alignment/power control functions are performed in BTS, not only the measurements part (as in ordinary GSM) but also, for performance reasons, the processing and command generation parts (located in the PD transfer controller).

Detailed Description Text - DETX (119):

An "immediate channel reservation" transfer sequence is exemplified in FIG. 11. The channel reservation (signal (5)) on the MPDCH downlink informs the MS of the channel on which the data frame (signal (6)) is to be received. If the data transfer takes place on an MPDCH, channel reservation may not be needed. The data frame includes reservation of an access slot on the MPDCH **uplink** for the MS to respond. In the response burst (signal (7)), one bit is allocated for acknowledging the data frame. If, as in the example, the acknowledgement is positive, the sequence is completed. In case of a negative acknowledgement, BTS sends a channel reservation for a more specified negative acknowledgement from the MS (defining blocks to be retransmitted), and for retransmission from BTS. This channel reservation also includes TA/PC commands. The retransmission then includes channel reservation for the MS to acknowledge and

for a possible further retransmission.

Detailed Description Text - DETX (122):
In a situation when the probable cell location can be limited to a small group of cells, a special type of paging message may be employed which combines paging with reservation of an access slot for the MS to respond. An example of using this type of paging is shown in the sequence diagram in FIG. 12. With the signal marked (5) in the figure, the paging command initiated by MSC reaches BTS. The PD transfer controller in BTS then generates a paging message (signal (7)) on the MPDCH downlink which includes reservation of an access slot on the MPDCH **uplink** for the MS to send a response burst (signal (8)). The paging response (signal (9) and (12)) transferred back to MSC includes information on the MS's cell location, which information (with the associated time when the paging response was received) is stored in the PD controller data base. The paging response also results in a channel reservation (signal 10)) on the MPDCH downlink for the data transfer. The channel reservation also includes TA/PC commands. When data is received from MSC (signal (13)), it is transferred on the reserved PDCH downlink (signal (16)). Channel reservation for an acknowledgement from the MS (signal (17)) and for possible retransmission may either be combined with the data frame (signal (16)) or included in the initial channel reservation (signal (10)).

Detailed Description Text - DETX (127):
The principles for the mentioned **uplink** state flags (USFs) and for the type of paging that reserves an access slot for the MS to respond are illustrated by the examples in FIG. 13. The series of slots that depict MPDCH downlink and **uplink** respectively represent time slots in consecutive TDMA frames. The figure shows two simple transfer examples, one mobile originated (with index 1) and one mobile terminated (with index 2). All control messages (except access bursts) comprise one block (i.e. 4 bursts). An USF on the MPDCH downlink marks a corresponding access slot on the MPDCH **uplink** as either "free" (for random access) or "reserved". In this example, USFs are coded individually per MPDCH downlink burst (by allocating a group of redundant bits, carrying one bit of information, for this purpose). An USF in TDMA frame n governs access in TDMA frame n+m. In this example, m-1.

Detailed Description Text - DETX (128):
The mobile originated data transfer starts with a random access burst from mobile station MS 1 in an access slot that is marked as "free" by an USF. BTS responds with a channel reservation command on the downlink and changes USF to "reserved" for the duration of the subsequent **uplink** data transfer. A downlink acknowledgement then completes the transfer sequence.

Detailed Description Text - DETX (129):
The mobile terminated transfer is initiated by a paging message to mobile station MS 2 providing the MS a reserved slot for its response burst. The paging response is followed by a channel reservation command and a subsequent downlink data transfer. After an acknowledgement from the MS in a reserved **uplink** block, the sequence is completed.

Claims Text - CLTX (24):
means for **allocating, from a common pool of physical channels,** a variable mix of packet data channels and regular cellular traffic channels determined by

demand;

Claims Text - CLTX (109):
means for **allocating, from a common pool of physical channels,** a variable mix of packet data channels and regular cellular traffic channels determined by demand;

US005590133A

United States Patent [19]

Billström et al.

[11] **Patent Number: 5,590,133**

[45] **Date of Patent: Dec. 31, 1996**

[54] **APPARATUSES AND MOBILE STATIONS FOR PROVIDING PACKET DATA COMMUNICATION IN DIGITAL TDMA CELLULAR SYSTEMS**

[75] Inventors: **Lars Billström**, Sonla; **Lars Wetterborg**; **Steinar Dahlin**, both of Järfälla; **Bengt Persson**, Djursholm, all of Sweden

[73] Assignee: **Telefonaktiebolaget LM Ericsson**, Stockholm, Sweden

[21] Appl. No.: **354,874**

[22] Filed: **Dec. 9, 1994**

[30] **Foreign Application Priority Data**

Dec. 10, 1993 [SE] Sweden 9304119

[51] **Int. Cl.**[6] **H04T 3/26**; H04Q 7/38

[52] **U.S. Cl.** **370/349**; 379/60; 455/332; 370/332; 370/337; 370/338; 370/403

[58] **Field of Search** 370/94.1, 95.1, 370/95.3, 60, 110.1, 79; 379/58, 59–63; 455/331, 54.1, 56.1; 340/825.44

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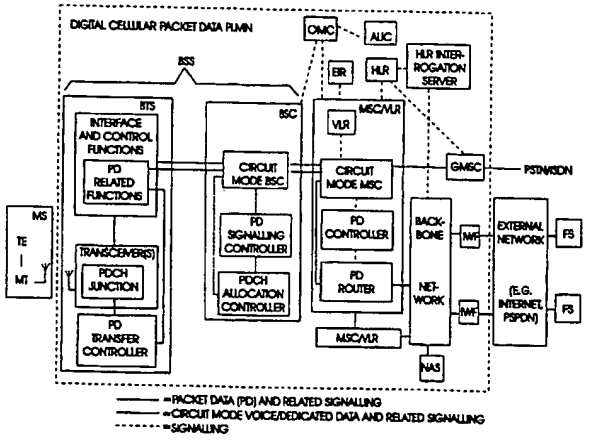
Primary Examiner—Benedict V. Safourek
Assistant Examiner—Seema S. Rao
Attorney, Agent, or Firm—Burns, Doane, Swecker & Mathis, L.L.P.

[57] **ABSTRACT**

Apparatuses and mobile stations are described which provide packet data services in TDMA (Time Division Multiple Access) cellular systems, based on providing shared packet data channels optimized for packet data. A first "integrated" embodiment utilizes the current cellular infrastructure to the extent possible consistent with functional and performance requirements. Shared packet data channels in base stations may be provided dynamically determined by demand. A packet data controller in each Mobile services Switching Center controls access to the packet data services. A packet data router in each MSC routes packets to and from the MSC service area. A backbone network interconnects packet data routers and Interworking Functions providing internetworking with external network(s). A second "separate" embodiment, in order to minimize the impact on the current cellular system, primarily utilizes the base station portion of the cellular system, relying for the remaining network parts on a separate mobile packet data infrastructure.

57 Claims, 20 Drawing Sheets



US-PAT-NO: 5802465

DOCUMENT-IDENTIFIER: US 5802465 A

TITLE: Data transmission in a radio telephone network

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Application Filing Date - AD (1):
19961001

Detailed Description Text - DETX (30):
In accordance with a first embodiment, the radio channel for a data route is a standard traffic channel of a cellular system which is intended for transfer of speech and non-packet shape data via broadcasting between a mobile station and a base station. When wishing to transmit data from a mobile station (i.e., mobile originated), the station requests the network via a base station for a channel using the same signalling channel as normally used when the station sends a request to connect a call. The signalling channel is a random access channel which all mobile stations of the call use. The channel runs from the mobile station to the base station, that is, it is a so-called **uplink** direction channel. Due to the random access, collisions may occur when channel requests enter simultaneously. In such an event the request has to be repeated. The request message includes a special bit configuration, an identification block with which the station reports of a service it wants to have, such as speech, data, packet data; in the present case, the identification configuration indicates that the desired service is transmission of packet data.

Detailed Description Text - DETX (35):
In accordance with the second embodiment, when a mobile station wishes to transmit data packets, i.e., mobile originated transfer, it sends a channel request page to a base station using the same random access channel upon which ordinary channel requests are transmitted. Said channel is in an **uplink** direction. All mobile stations of the cell employ the same channel for speech channel requests. The Mobile Switching Center decides, after receiving the request, which channel the mobile station should move to for data transmission. The channel can be either a standard traffic channel or a control channel. The control channel can be the same random access channel on which the channel requests are transferred from the mobile stations to the base station. The network establishes a traffic channel provided it has been selected to be the transfer channel. The base station transfers information to the mobile station on whether it is expected to use the standard traffic channel or the control channel for data transmission. Such information is transmitted on the Common Control CHannel, on the Access Grant CHannel, upon which channel the channel assignment is sent to the mobile stations. The mobile station moves to the traffic or control channel thus assigned, starting immediately to transmit packet data. In the course of the transmission, the channel may be handed over from the traffic channel to the control channel, and vice versa, even several times. On termination of transmission, the channel is disassembled and it is released for other uses. The transfer ends after a given time elapses or when a "packets over" message is received from the station.

Detailed Description Text - DETX (42):

According to FIG. 2, the logical channels are divided into traffic channels TCH and control channels CCH. The traffic channels are intended for transferring coded speech and data. Each of them can be transferred at full rate or half rate. The control channels CCH are intended to transfer signalling and synchronization data, and three types of channels can be distinguished thus: Broadcast **Channels, Common Channels and Dedicated** Control Channels. Below, "**uplink**" refers to the direction from a mobile station to a base station and "downlink" the direction from a base station to a mobile station.

Detailed Description Text - DETX (49):

a Random Access CHannel, RACH, **uplink** direction only, on which the mobile stations send a request for a dedicated channel

Detailed Description Text - DETX (55):

In accordance with the present invention, a Traffic CHannel (bidirectional), TCH, a Paging CHannel, PCH, (unidirectional, downlink), a Random Access CHannel, RACH, (unidirectional, **uplink**), and an Access Grant CHannel, AGCH, (unidirectional, downlink) are made use of. Channels of equivalent types can also be found in digital cellular systems other than GSM.

Detailed Description Text - DETX (66):

Reference is made to FIG. 9 showing packet data transfer in mobile station originated mode. The figure is equivalent to FIG. 5 and the description thereof, with an additional remark that also a mentioning has been added therein on which channel each message is transmitted. So, a mobile station sends a packet data channel request to a base station using a common Random Access CHannel RACH, which all stations in the cell use when requesting a radio channel. The base station replies by a traffic **channel assignment on the common Access Grant CHannel** AGCH, whereafter the packet data transfer and acknowledgement of reception are carried out on the traffic channel. The paging transmitted on the Random Access CHannel RACH contains a value 001 in the "Establishment Cause" as in FIG. 3. Said channel paging request is a modification of a standard channel paging of the GSM system. The value "001" would mean that the direction of the packets is from the network to the mobile station. The purpose thereof is so that the value of the "Establishment Cause" field is different in the mobile originated case and the mobile terminated case is to ensure that the priority of the mobile terminated case is higher because the network has already been made to prepare a connection.

US005802465A

United States Patent [19]

Hamalainen et al.

[11] Patent Number: 5,802,465

[45] Date of Patent: Sep. 1, 1998

[54] **DATA TRANSMISSION IN A RADIO TELEPHONE NETWORK**

[75] Inventors: **Jari Hamalainen**, Tampere; **Timo Jokiaho**, Vantaa, both of Finland

[73] Assignee: **Nokia Mobile Phones Ltd.**, United Kingdom

[21] Appl. No.: **724,375**

[22] Filed: **Oct. 1, 1996**

Related U.S. Application Data

[63] Continuation of Ser. No. 301,340, Sep. 6, 1994, abandoned.

[30] **Foreign Application Priority Data**

Sep. 6, 1993 [FI] Finland 933894

[51] **Int. Cl.**[6] **H04Q 7/20**

[52] **U.S. Cl.** **455/403**; 455/452; 455/560

[58] **Field of Search** 455/403, 422, 455/450, 452, 455, 509, 516, 550, 560, 435; 370/389, 338

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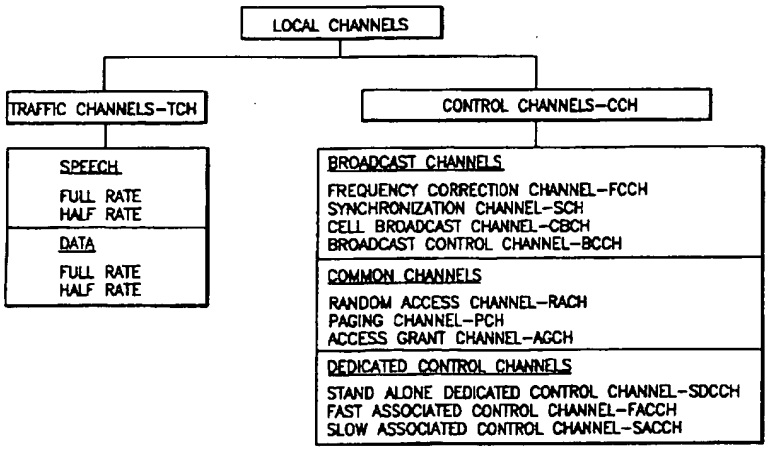
Primary Examiner—Dwayne D. Bost
Assistant Examiner—William G. Trost
Attorney, Agent, or Firm—Perman & Green, LLP

[57] **ABSTRACT**

For bidirectional transmission of packet data, a packet data service unit (Agent) is disposed in a digital cellular system connected to be in association with a Mobile Switching Center, and connecting the cellular network to the date network. As a mobile station is connected to the packet data service unit, signalling related to connection formation characteristics of the network is first accomplished. As a result thereof, the mobile station and the data service unit are provided with a number of stored parameters relating to each other. This situation creates or is called a virtual channel. When a mobile station wants to transmit or receive data packets between the mobile station and the data service unit a packet data transfer channel is established making use of the parameters of the virtual channel and thereby using substantially less signalling than the channel establishment signalling characteristic of the network, one part thereof being a radio channel and the other part a time slot in a digital trunk line. On termination of data packet transfer, at least said radio channel is disassembled but the virtual channel is maintained until the disconnection of the mobile station from the data service.

32 Claims, 7 Drawing Sheets



US-PAT-NO: 6185430

DOCUMENT-IDENTIFIER: US 6185430 B1

TITLE: Voice call group function for a satellite based air traffic control system

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Application Filing Date - AD (1):
19971126

Claims Text - CLTX (5):
a call group controller for assigning voice call group **assigned channel to a common** voice call group, said voice call group assigned channels comprising selected ones of said first group communication channels and selected ones of said second group communication channels, wherein said voice call group assigned **channels includes a dedicated uplink** to allow said air traffic control station to speak at any time and always be heard by each of the other members of said common voice call group;

Claims Text - CLTX (50):
assigning voice call group **assigned channels to a common** voice call group, said voice call group assigned channels comprising selected ones of said first group communication channels and selected ones of said second group communication channels, wherein said step of assigning voice call group **assigned channels to a common** voice call group includes the step of establishing a dedicated uplink to allow said air traffic control system to speak at any time and always be heard by each of the other members of said common voice call group;

US006185430B1

(12) **United States Patent**
Yee et al.

(10) **Patent No.: US 6,185,430 B1**
(45) **Date of Patent: *Feb. 6, 2001**

(54) **VOICE CALL GROUP FUNCTION FOR A SATELLITE BASED AIR TRAFFIC CONTROL SYSTEM**

(75) Inventors: **David Moon Yee**, Scottsdale; **Robert Henry Bickley**, Paradise Valley; **Philip John Zucarelli**, Glendale; **Theodore Woolley Keller**; **Jeffrey S. Osman**, both of Scottsdale; **Randall K. Derr**, Phoenix, all of AZ (US)

(73) Assignee: **Motorola, Inc.**, Schaumburg, IL (US)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Under 35 U.S.C. 154(b), the term of this patent shall be extended for 0 days.

(21) Appl. No.: **08/979,798**

(22) Filed: **Nov. 26, 1997**

(51) **Int. Cl.**[7] **H04B 7/00**

(52) **U.S. Cl.** **455/519**; 455/12.1; 455/428; 455/430; 455/431; 455/408; 379/184; 379/185; 379/187

(58) **Field of Search** 455/518, 519, 455/12.1, 13.1, 13.2, 426, 427, 428, 430, 431, 406, 407, 408, 462, 463, 464; 379/114, 134, 177–187, 1

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Primary Examiner—Dwayne D. Bost
Assistant Examiner—Charles Craver
(74) *Attorney, Agent, or Firm*—Bradley J. Botsch

(57) **ABSTRACT**

Voice call group functionality is provided in a satellite based air traffic control system to allow air traffic controllers and pilots of one or more aircraft to establish and maintain voice communication over a group call. A pilot of an aircraft may maintain voice communication with the same air traffic controller the entire duration of the flight over the entire globe. Voice communication between the pilot of an aircraft may be handed off from one air traffic controller to another by switching voice call groups. The voice call group functionality allows an air traffic controller to communicate simultaneously with pilots of different aircraft, and also allows pilots of different aircraft to communicate with each other.

25 Claims, 8 Drawing Sheets